

WHAT IS CLAIMED IS:

- 1 1. A semiconductor device comprising:
 - 2 a substrate having a well of a first conductivity type formed thereon;
 - 3 a gate electrode formed on the substrate
 - 4 a notched spacer formed of a first material alongside the gate electrode, the notched
 - 5 spacer having a notch formed along the surface of the substrate;
 - 6 a first impurity region of the first conductivity type formed in the substrate at a first ion
 - 7 implant angle from the surface of the substrate, wherein only the notched spacer and the gate
 - 8 electrode act as a mask;
 - 9 a second impurity region of a second conductivity type formed in the substrate at a
 - 10 second ion implant angle from the surface of the substrate, wherein the notched spacer and the
 - 11 gate electrode act as a mask;
 - 12 a second spacer formed alongside the notched spacer; and
 - 13 one or more additional impurity regions of the second conductivity type formed in a
 - 14 source/drain region in the substrate.
- 1 2. The semiconductor device of claim 1, wherein the notched spacer is formed of silicon
- 2 dioxide.
- 1 3. The semiconductor device of claim 1, wherein the notched spacer is formed of silicon
- 2 nitride.

1 4. The semiconductor device of claim 1, wherein the second spacer is formed of a material
2 selected from the group consisting essentially of silicon dioxide and silicon nitride.

1 5. The semiconductor device of claim 1, wherein the notched spacer is completely removed
2 along the surface of the substrate.

1 6. The semiconductor device of claim 1, wherein the first ion implant angle is oblique to the
2 surface of the substrate.

1 7. The semiconductor device of claim 1, wherein the second ion implant angle is normal to
2 the surface of the substrate.

1 8. The semiconductor device of claim 1, wherein the first impurity region extends beneath
2 at least a portion of the gate electrode.

1 9. The semiconductor device of claim 1, wherein the first impurity region extends further
2 laterally under the gate electrode than the second impurity region.

1 10. A semiconductor device comprising:
2 a substrate having a gate electrode formed thereon;
3 a notched spacer formed alongside the gate electrode such that the notched spacer does
4 not contact the substrate, the notched spacer being a single homogeneous spacer; and
5 a second spacer formed alongside the notched spacer.

1 11. The semiconductor device of claim 10, wherein the notched spacer is formed of silicon
2 dioxide.

1 12. The semiconductor device of claim 10, wherein the notched spacer is formed of silicon
2 nitride.

1 13. The semiconductor device of claim 10, wherein the second spacer is formed of a material
2 selected from the group consisting essentially of silicon dioxide and silicon nitride.

1 14. The semiconductor device of claim 10, further comprising a first ion implant region
2 extending beneath at least a portion of the gate electrode.

1 15. The semiconductor device of claim 10, further comprising a first ion implant region and a
2 second ion implant region, the second ion implant region being formed by an ion implant at an
3 angle normal to the surface of the substrate wherein the second spacer acts as a mask, and the
4 first ion implant region extending further laterally under the gate electrode than the second
5 impurity region.

1 16. A method of forming a semiconductor device, the method comprising:
2 forming a gate electrode on a substrate, the substrate having a first conductivity type;
3 forming a notched spacer alongside the gate electrode such that the notched spacer is
4 thinner along the surface of the substrate, the notched spacer comprising a single homogenous
5 layer;
6 performing a first ion implant wherein only the gate electrode and the notched spacer act
7 as masks during the first ion implant, the first ion implant using ions of the first conductivity
8 type; and
9 performing one or more second ion implants using ions of a second conductivity type.

1 17. The method of claim 16, wherein the step of forming a notched spacer comprises forming
2 a first layer and a second layer, forming a mask out of the second layer on the first layer such
3 that the first layer alongside the gate electrode is covered by the mask, etching the first layer such
4 that the first layer along the surface of the substrate next to the gate electrode is removed,
5 removing the mask.

1 18. The method of claim 17, wherein the mask is formed of silicon nitride.

1 19. The method of claim 17, wherein the mask is formed of silicon oxide.

1 20. The method of claim 16, wherein the step of performing a first ion implant is performed
2 by implanting ions at an oblique angle to the substrate such that impurities of the first
3 conductivity type are implanted in the substrate below the gate electrode.

1 21. The method of claim 16, wherein the step of performing one or more second ion implants
2 are performed at an angle normal to the surface of the substrate.

1 22. The method of claim 16, wherein the notched spacer is formed of silicon dioxide.

1 23. The method of claim 16, wherein the notched spacer is formed of silicon nitride.

1 24. A method of forming a semiconductor device, the method comprising:

2 forming a gate electrode on a substrate, the substrate having a first conductivity type;

3 forming a first layer over the substrate and the gate electrode;

4 forming a second layer over the first layer;

5 removing a portion of the second layer such that a spacer mask is formed on the first

6 layer on the side of the gate electrode;

7 etching the first layer to form a notched spacer wherein the spacer mask acts as a mask,

8 the etching process removing at least a portion of the second layer along the surface of the

9 substrate;

10 removing the spacer mask;

11 performing a first ion implant after the spacer mask has been removed, the first ion

12 implant using ions of the first conductivity type; and

13 performing one or more second ion implants using ions of a second conductivity type.

1 25. The method of claim 24, wherein the step of performing a first ion implant is performed

2 by implanting ions at an oblique angle to the substrate such that impurities of the first

3 conductivity type are implanted in the substrate below the gate electrode.

1 26. The method of claim 24, wherein the step of performing one or more second ion implants

2 are performed at an angle normal to the surface of the substrate.

1 27. The method of claim 24, wherein the first layer is formed of silicon dioxide.

1 28. The method of claim 24, wherein the second layer is formed of silicon nitride.